Claims

1. Method for controlling a glow discharge plasma in a gas or gas mixture under atmospheric conditions, in a plasma discharge space comprising at least two spaced electrodes, wherein at least one plasma pulse is generated by applying an AC plasma energizing voltage to said electrodes causing a plasma current and a displacement current, said at least one plasma pulse comprising an absolute pulse maximum, characterized in that, said method comprises the step of controlling said energizing voltage such that a relative decrease of said displacement current is provided before said pulse maximum.

2. Method according to claim 1, further comprising a step of synchronizing said relative decrease of said displacement current with the onset of said plasma pulse.

3. Method according to any of the previous claims, wherein said relative decrease of said displacement current is provided within a time interval, wherein said time interval is of an order of a microsecond, preferably fractions of a microsecond.

4. Method according to claim 3, wherein said relative decrease of said displacement current within said time interval is at least 100%.

5. Method according to any of the previous, wherein said relative decrease of said displacement current results in a relative negative value for said displacement current.

6. Method according to any of the previous claims, wherein before said pulse maximum said energizing voltage is controlled in a manner such that a second derivate of said energizing voltage over time is proportional and of opposite sign to a first derivative over time of plasma current.

7. Method according to any of the previous claims, wherein at least one of said electrodes is covered by a dielectric material.

8. Method according to claim 7, wherein said dielectric material has a secondary electron emission between 0.01 and 1.

9. Method according to any of the previous claims, wherein said plasma is operated at a voltage that is a few percent higher than the minimum voltage necessary for maintaining said plasma.

10. Arrangement for controlling a glow discharge plasma in a discharge space having at least two spaced electrodes, means for introducing in said discharge space a gas or gas mixture under atmospheric conditions, a power supply for energizing said electrodes by applying an AC plasma energizing voltage to said electrodes for generating at least one plasma pulse and causing a plasma current and a displacement current, said at least one plasma pulse comprising an absolute pulse maximum, and means for controlling said plasma, characterized in that, said means for controlling said plasma are arranged for controlling said energizing voltage such that a relative decrease of said displacement current is provided before said pulse maximum.

11. Apparatus according to claim 10, further comprising means for synchronizing said relative decrease of said displacement current with the onset of said plasma pulse.

12. Apparatus according to any of the claims 10 or 11, wherein at plasma generation said stabilization means are arranged for decreasing said displacement current to a value relatively less than a value of said displacement current before plasma breakdown.

13. Apparatus according to any of the claims 10-12, wherein said stabilization means are arranged for controlling said energizing voltage in a manner such that at plasma generation said relative decrease of said displacement current is at least 100% and is provided in fractions of a microsecond.

14. Apparatus according to any of the claims 10-13, wherein said stabilization means are arranged for providing a first derivative

over time of an absolute value of said energizing voltage and for sharply decreasing said first derivative over time of said absolute value of said energizing voltage at plasma generation.

15. Apparatus according to any of the claims 10-14, wherein said stabilization means are arranged for controlling said energizing voltage in a manner such that, before said pulse maximum, a second derivate of said energizing voltage over time is proportional and of opposite sign to a first derivative over time of plasma current.

16. Apparatus according to claim 15, wherein said first derivative of said plasma current is provided by inductor means connected in series with said electrode or electrodes of said discharge space.

17. Apparatus according to any of the claims 10-15, wherein said stabilization means comprise pulse generator means providing voltage pulses superimposed at said energizing voltage at said electrodes.

18. Apparatus according to claim 17, wherein said pulse generator is formed by a power amplifier, having input or control terminals which are connected to means for sensing plasma current, and wherein output terminals of said amplifier are connected in series with said power supply means and said electrodes for superimposing a voltage pulse at said energizing voltage.

19. Apparatus according to any of the claims 10-18, wherein said stabilization means comprise electronic inductor circuitry.

20. Apparatus according to any of the claims 10-19, wherein said electrodes are spaced over a distance of between 0.01 mm and 3 cm.

21. Apparatus according to any of the claims 10-20, wherein said gas is selected from a group comprising Helium, Argon, Nitrogen, Air, Oxygen, Carbon Dioxide, Ammonia and a mixture comprising any of said gasses of said group.

22. Apparatus according to any of the claims 10-21, wherein said gas is a mixture of a noble gas and a chemically active gas.

23. Apparatus according to any of the claims 10-22, wherein said AC power supply means are arranged for energizing said electrodes with an energizing voltage at a frequency between 10 kHz and 50 MHz.

24. Device for treating a surface of a substrate, comprising an apparatus according of any of the claims 10 - 23.